MAXIMUM SPECIFIC GRAVITY OF BITUMINOUS PAVING MIXTURES

AASHTO T 209

GLOSSARY

Specific gravity -- the ratio of the mass in air of a volume of material to the mass in air of an equal volume of water.

Mercury Manometer -- a tube sealed at one end and filled with mercury, which, when subjected to a vacuum, will register a comparison between the applied vacuum and the nearly total vacuum that exists in the sealed end. The degree of vacuum is expressed as absolute pressure or residual pressure, in mm. Smaller numbers (less pressure) indicate more vacuum.

SCOPE

The volumetric properties of HMA must be controlled during design and production in order to produce durable pavements. A test to measure the volume of a mixture with all the air voids removed is needed to measure this durability. The maximum specific gravity (G_{mm}) of a HMA is the ratio of the weight of the loose sample to the weight of an equal volume of water at the standard temperature of 77°F (25°C)

G_{mm} is used along with the bulk specific gravity (G_{mb}) of the compacted mixture to determine air voids (P_a). It is often used also for determining the percent of compaction in laboratory specimens or during roadway compaction.

The procedure using vacuum containers for plant-produced mixture is the procedure that will be discussed herein. Other procedures are covered in AASHTO T 209.

SUMMARY OF TESTS

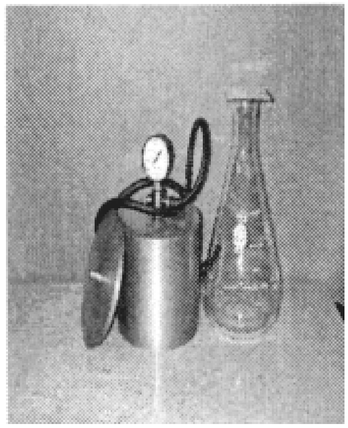
Apparatus

Vacuum Container, capacity of at least 2000 mL, capable of withstanding the full vacuum applied and having No. 200 (75 µm) wire mesh covering the hose opening.

Vacuum System, capable of subjecting contents to partial vacuum of 25.5 - 30 mm Hg.

Residual Pressure Manometer, capable of measuring residual pressure down to 30 mm Hg (4.0 kPa).

Thermometer, conforming to requirements of ASTM E 1 with subdivisions and maximum scale error of 1°F (0.5°C).



Pycnometer and Flask

SAMPLE SIZE

The size of the sample shall conform to the following requirements. Samples larger than the capacity of the vacuum container may be tested a portion at a time.

Maximum Aggregate Size	Minimum Sample Size
1 ½ in. (37.5 mm)	4000 g
1 in. (25.0 mm)	2500 g
3/4 in. (19.0 mm)	2000 g
1/2 in. (12.5 mm)	1500 g
3/8 in. (9.5 mm)	1000 g
#4 (4.75 mm)	500 g

Calibration of Vacuum Container

<u>Weighing-in-Air</u>

1. Fill the container with water at 77 ± 1°F (25°C ± 0.5°C).

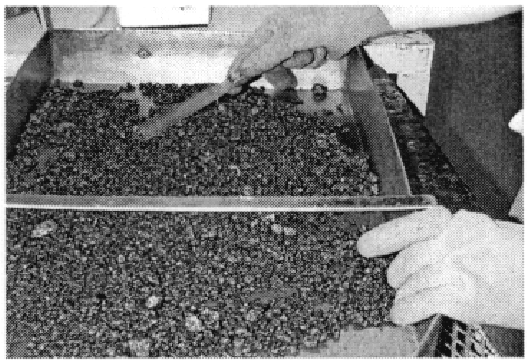
2. Place the cover or a glass cover plate on the container, being sure that no air bubbles are trapped.

3. Dry the outside of the container and weigh it to the nearest 0.1 gram (D).

   Note: If the temperatures other than 77 ± 1°F (25 ± 0.5°C) are encountered during testing, the vacuum container should be calibrated at higher and lower temperatures and a calibration curve developed.

Procedure

1. Separate particles of the sample without fracturing any aggregate until the fine aggregate particles are not larger than 1/4 in. (6.3 mm). (Sample may be placed in large pan and warmed in oven until workable)



Stirring Sample and Breaking Clumps

2. Dry sample to constant weight in oven at 221 ± 9°F (105 ± 5°C). (This drying and curing is combined with any warming needed to separate the sample).

3. Cool the sample to room temperature, place it in a tared vacuum container, and weigh to the nearest 0.1 gram (A).

4. Add sufficient water at a temperature of 77°F (25°C) to cover the sample completely.

5. Remove air trapped in sample by applying gradually increasing vacuum until the residual pressure manometer reads 25.5 - 30 mm Hg.

6. Agitate container and contents during the vacuum period either continuously by a mechanical device, or manually by vigorous shaking at intervals of about 2 minutes.

7. After 15 ± 2 minutes release the vacuum by increasing pressure slowly.

<u>Weighing-in-Water</u>

1. Suspend the container and contents in the water bath and determine the weight (C) after 10 ± 1 min. immersion.

2. Empty the container immediately following the weighing of the container and sample.

3. Suspend the container in water without delay and determine the weight (B)

4. Calculate the theoretical maximum specific gravity to three decimal places (0.000) as follows

$$\text{Max. Sp. Gr.} = \frac{A}{A - (C - B)}$$

where:

A = weight of dry sample in air, g
B = weight of container in water, g
C = weight of container and sample in water, g

Weighing-in-Air

1. Fill the vacuum container with water and adjust the contents to a temperature of 77 ± 2°F (25 ± 1°C) or apply a correction.

2. Determining the weight (E) of container and sample within 10 ± 1 min.

3. Calculate the theoretical maximum specific gravity to three decimal places (0.000) as follows:

Water at 77 ± 2°F (25.0 ± 1°C)

$$G_{mm} = \frac{A}{A + D - E}$$

where:

A = weight of dry sample in air, g
D = weight of container filled with water, g
E = weight of container filled with water and sample, g

Supplemental Procedure

If the pores of the aggregates are not thoroughly sealed with binder film, they may become saturated with water during the application of the vacuum. To determine if this has occurred, drain the water from the sample by decanting through a towel, and break open several large pieces of aggregate. If the broken surfaces indicate wetness the following procedure should be applied.

Note: This procedure has an insignificant effect on the test results if the mixture contains individual aggregate with a water absorption below 1.5 percent.

1. Spread sample before an electric fan to remove surface moisture.

2. Break conglomerations of mixture by hand and intermittently stir the sample.

3. Weigh the sample at 15-minute intervals. (When the loss in weight (A_1) is less than 0.05 percent for this interval the sample may be considered to be surface dry)

4. Calculate the theoretical maximum specific gravity to three decimal places (0.000) as follows:

Weighing at 77 ± 2°F (25.0 ± 1°C)

Weighing – in - Air $G_{mm} = \dfrac{A}{A_1 + D - E}$

where:

A = weight of dry sample in air, g
A_1 = weight of surface-dry sample, g
D = weight of container filled with water, g
E = weight of container filled with water and sample, g

Weighing – in - Water $G_{mm} = \dfrac{A}{A_1 - (C - B)}$

where:

A = weight of dry sample in air, g
A_1 = weight of surface-dry sample, g
B = weight of container in water, g
C = weight of container and sample in water, g